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Innovation effects of tradable emission allowance schemes: the treatment of new entrants and shutdowns

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1. Introduction: „putty-clay“, “embodied technological change“, and market entry for new firms

Innovations in the wider sense - following Schumpeter (1934), new combinations of production factors and their diffusion in the market – which lead to long-term reductions in social abatement costs, are among the central objectives of environmental policy. The conduciveness to economic agents’ innovative activity is, therefore, one of the core criteria for evaluating environmental policy instruments (Kneese/Schultz 1975) and their associated design variants.

Especially for “energy intensive” industry sectors, it is frequently argued that *substantial emission reductions* – which require new combinations of production factors - can be realised primarily in the course of

- new investments,
- plant replacements, and
- capacity extensions,

as suggested by Schleich et al. (2002) and Letmathe/Wagner (2003, referring to Johansen 1972 and Bosworth 1976). After production equipment is installed, the potential for further emission savings is very limited (apart from “add-on” abatement technologies, which are feasible or cost-effective only for certain pollutants, and currently not for CO_2). This concept has been named „putty-clay“ (Letmathe/Wagner 2003: 20): “putty” is deformable and modifiable and thus resembles the flexibility up to the production equipment decision, while the fired “clay” is unchangeable to a high degree, and stands for the situation after this decision.

Furthermore, and partly as a consequence of the „putty-clay” problem, *technical progress* is often „embodied“ in new „vintages“ of production equipment, and can therefore only be realised in the course of installing such new equipment. This has lead to the concept of “embodied technological change” (Burmeister/Dobell 1970).

To the extent that these propositions hold, a central factor for emissions trading’s impact on diffusion – and indirectly also for R&D, especially by equipment producers – is how well its design supports incentives for installing new equipment and/or replacing old one. Furthermore, when the crucial moment for innovation is the decision on new equipment, it is likely to matter a lot *how progressive* this new equipment is, as it will be in place for many years to come.

Hence, two aspects are important for policy makers:

1. New investments, plant replacements, and capacity extensions should at least not be disfavoured compared to existing installations. This will be called “investment incentives” in the following.
2. As to the decisions on *which* new technology to install when investing, emissions trading design must
   a) retain incentives to use technologically advanced versions of given technologies;

b) not disfavour, among new technologies, those ones that look the most cost-efficient ones in a long-term perspective. Although no individual can know in advance which technologies these will be, a criterion for policy should be that it does not interfere and deviate from the decisions taken by informed market individuals who take their expectations of an emissions-constrained future - with substantially increasing emissions prices - into account. As a second aspect, overcoming market failures which lead to overly short-term optimisation decisions should be a further, albeit hard to make operational, criterion.

A further argument for an economically based analysis of the "new entrants rules" applies a different, namely actor related, perspective. Geroski (1991) suggests that new *firms* are often important actors for new products and production processes and therefore firm entry conditions are a very important factor for the dynamics of the economy (see also Johnstone 1998: 34). Moreover, Ashford (2002) proposes in accordance with Christensen (1997) that „incumbent" firms hardly ever are responsible for the introduction or diffusion of *radical* (in his terms: „disruptive") innovations. In all situations in which radical changes of innovation paths are needed - due to the ecological problem pressure – society will have to rely on new enterprises entering the market, according to Ashford.

When the primary allocation of the tradable allowances is not done by an auction, but they are given out for free according to the installations' past emissions or activity levels ("grandfathering" or "benchmarking" when based on past activity levels), then all owners of existing installations receive free allowances, while owners of new installations have to purchase the allowances they need on the market. This might constitute a disadvantage for new installations and/or new market entrants. Whether this could lead to disincentives for new installations, and whether it suggests that the regulator set up a special reserve from which to allocate free allowances to new installations, is a central question in this paper. Furthermore, possible variants of free allocation to new installations are discussed.

Finally, as will be shown in the course of this paper, different rules for new installations can influence the allowance price, which in itself is a central innovation factor, as it affects the profitability of different abatement adoption decisions, and in the long run can affect also the profitability of R&D decisions. In this context, also the rules for closed plants play an important role.

The remainder of this paper is organised as follows: Chapter 2 lays out the general arguments for and against new emitters receiving free allocation of allowances from a special "new entrants reserve". It also addresses arguments relating to potential "leakage effects" and shutdown rules. Chapter 3 presents different alternative approaches of allocating allowances to new entrants and discusses their relative advantages. Chapter 4 describes the interplay of the rules for new entrants and plant shutdowns which two common allocation modes for *incumbent* firms -

grandfathering based on absolute emissions and benchmarking based on production output. Chapter 5 gives an overview of the empirical applications of new entrant and shutdown rules, relating to the most prominent existing allowance trading systems in the USA and Europe. Chapter 6 concludes.

2. Rationale for explicit new entrant and shutdown allocation rules

This chapter deals with the question of whether a "new entrants reserve" for free allocations to new emitters is economically necessary. It first makes clear in section 2.1 that a pure historical allocation mode – which includes the need for new emitters to buy their required allowances on the market – does not necessarily mean that new plants will be erected in a socially suboptimal degree. Section 2.2 describes cases in which a new entrants reserve may be needed nevertheless.[1] Sections 2.3 in addition addresses the interplay of new entrant rules and shutdown rules, the latter being intended to limit potential "leakage effects" resulting from incentives to shift production to non-regulated countries or states.

2.1 The general issues: The difference between rents and incentives

As noted in the introduction, potential financial disadvantages for new installations or new actors exist only under regimes of free allocation according to plants' historic emissions or historic activity levels. The problem affects thus grandfathering (allocation according to plants' past emissions) as well as benchmarking (allocation according to plants' past production output or energy input)[2], but it does not affect approaches of auctioning allowances to installation operators.

It is important to note, now, that when owners of new installations must purchase the needed allowances and thus have a financial disadvantage compared to owners

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[1] Lambie (2002) gives a comprehensive discussion on the potential problems of a policy that does not implement a "new entrants reserve" and forces new emitters to buy allowances on the market.

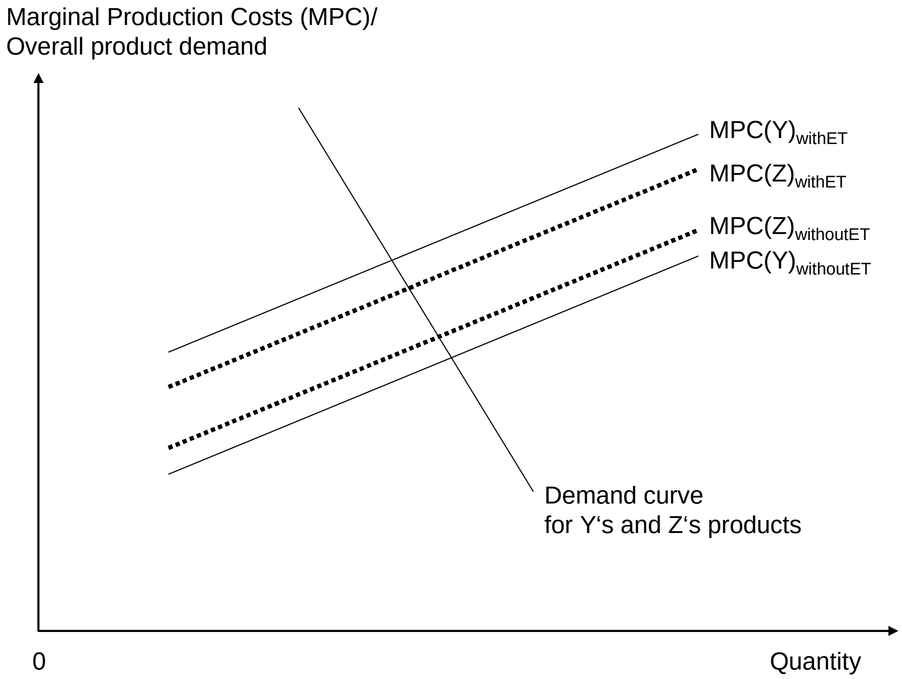
[2] The terms "grandfathering" and "benchmarking" are used with different meanings in the economic literature: grandfathering can either mean allocation according to *any* historical metrics, such as emissions, energy input, or production output, or it can alternatively be used only for allocations according to historic *emissions*. In this paper, grandfathering is understood in the second way, and means allocation only to historic emissions. Benchmarking means, in any case, allocation according to some performance standard: it could be, for instance, according to the installations' energy input (as done in the "Acid Rain Program" SO_2 trading scheme in the USA, see for example Hansjürgens (1998)), or according to production output (as done by some EU Member States in the EU CO_2 Emissions Trading Scheme (EU-ETS, see DEHSt (2005)). While in both cases, allocation was according to installations' *past* energy input or production output, it can instead also be done according to installations' *current* or *expected* energy input/production output. The so called "option rule" in the German allocation rules under the EU-ETS applies expected production output (see DEHSt 2005). In this paper, however, the term benchmarking refers only to allocation according to historic metrics.

of existing installations, this does still not automatically mean that the *incentives* for investing in new installations are reduced as well (Lambie 2002, Graichen/Requte 2003). Rather, in a well-functioning market with low transaction costs, no substantial uncertainties and no (or little) market power misuse, it should not make any difference to the incentives, since it should be profitable for the owners of the existing installations to sell to the new installations' owners, rather than keep, the allowances they received for free, as long as the new plants are indeed more emission-efficient.

The reason lies in the "opportunity costs" - the revenues foregone when not selling the allowances. If the new installations are indeed more emission-efficient than the existing ones, they will provide a higher marginal productivity of each allowance, meaning they can use each allowance (or each emission unit) to produce more products. In this case, the owners of the new installations are willing to pay a higher price for the allowances than what is an allowance's marginal product in an existing installation (Allen Consulting 2000: 32, Graichen/Requate 2003: 21, Hahn et al. 2003: 38). Put shortly, for the owners of the existing installations the opportunity costs (revenues foregone when not selling) of each allowance are higher than the productivity of each allowance in their own installation. Only if markets do not function satisfactorily, misallocations with suboptimal *incentives* for plant replacement will occur. In all other cases, the uneven financial burdens for the owners of existing and new installations would entirely be an issue of distribution of *rents*.

This can be illustrated by means of the following figure 1, which can be found in Harrison/Radov (2002) or Bode (2005) and is extended here to two plants. The two plants are named Y and Z and assumed to be owned by different operators. Both are assumed to produce homogeneous outputs. Y is an old plant of which the capital costs have been written off (and they would be sunk costs anyway unless substantial revenues could be expected from its salvage value). Z is a new plant. Z is assumed to have a higher thermal efficiency; therefore its fuel costs per unit of output are lower and much likely overall variable costs are lower than for plant Y. But from the perspective of an investor considering installing plant Z, he must include capital costs, too, since these are not "sunk". Before the plant is erected, capital costs have to be incorporated (together with the expected variable costs) as long-run marginal costs. When plant Z has lower overall marginal production costs ("MPC(Z)" in figure 1) than plant Y ("MPC(Y)" in figure 1), it will successfully compete against plant Y. This applies also without emissions trading. But under emissions trading, some new plants become competitive which would not be without emissions trading. This is due to the opportunity costs, irrespective of the allocation: The owner of plant Y would save costs $MPC(Y)_{withoutET}$ if he ceased production and in addition he would receive allowance sales revenues in the amount $[MPC(Y)_{withET} - MPC(Y)_{withoutET}]$ from the owner of Z for the allowances he does not need any more. In this example the sum of these two components (= $MPC(Y)_{withET}$) is larger than the costs of plant Z (including allowance expenses), so the owner of plant Y will shut down and sell the allowances to the owner of Z.

Figure 1: Competition of two plants under marginal conditions, with and without emissions trading



Source: Own illustration based on Harrison/Radov (2002) and Bode (2004)

2.2 Potential reasons for discrimination of new installations

a) Market power

AGO (1999: 34f.), referring to Hinchy et al. (1998: 24), point out that the relative financial advantage (i.e., difference in economic rents) which accrues to incumbent emitters, and appears to be a pure „distributional issue“ at first glance, may have allocation distortion effects: This is because incumbent emitters can use their lower financial burden from emissions trading (compared to new emitters) to construct economic barriers – especially with a view to hindering new competitors on product markets. Analogously, Woerdman (2000: 620) states in accordance with Nentjes et al (1995) that incumbent firms would be in a favourite position under situations of attempted predatory pricing, since (other factors being equal) they can outlast the new entrants in incurring losses due to the higher financial resources they obtain from the free allowance endowments (see also Koutstaal 1997).

This situation may be aggravated when incumbents have market power in the allowance market which they can use to exert „exclusionary“ market power against competitors (Misiolek/Elder 1989).[3] The potential to use exclusionary market power depends on the concentration of emissions within the trading scheme and among firms covered by the trading scheme (Johnstone 1998: 35). It also depends on some design features of the trading system. For example, allowances denominated for several years would increase the potential for such manipulation; also unlimited banking bears higher potential (ibid.), not least since it reduces the costs of "hoarding" allowances.

In general, especially when credit is given to Ashford's (2002) propositions mentioned above on the innovation related behaviour of powerful incumbent firms, the issue of market power described in this section deserves attention.

b) State-owned firms

Allen Consulting (2000: 33) report that the pure „opportunity cost" principle can be absent when important „incumbents" are in public ownership and political (e.g., employment) interests influence or even dominate their economic decisions. Also production decisions that are based on average rather than marginal costs - e.g., in the case public electricity utilities subject to price controls – change the picture.

c) Capital constraints

Economic rents for the incumbent firms alone do not appear to be a sufficient condition for a price war against new entrants which an incumbent can be sure to win, because a new entrant could always be assumed to raise the necessary funds on the capital markets. Therefore, competition distortions also require some degree of capital constraints at least on the side of the new entrant firms. Lambie (2002) quotes Koutstaal (1997) as assuming this to be the case under capital market imperfections. However, the question is whether capital market imperfections – no matter how they are defined – are indeed a necessary condition for capital constraints: Instead, already if real interest to be paid on foreign debt is systematically higher than capital service rates on equity capital (and equity capital can not be raised without cost), some degree of capital restrictions, and therefore a competitive disadvantage for new emitters, must be expected. And the fact that markets judge firms' creditworthiness according to their equity-debt ratio rather appears to be a sign of efficient capital markets, albeit under the real world conditions of imperfect information for suppliers or brokers of capital.[4]

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3 Betz (2003: 170) points out that Hinchy et al. (1998) assumed market transaction costs of 10-30% of the allowance prices – a very high value compared to, e.g., the actual transaction costs under the Acid Rain Program of about 1 %. However, it must be kept in mind that financial authorities may exhibit value added tax on each trade. To the extent that these are not completely deductable, they could well assume a degree comparable to that of Hinchy's transaction costs.

4 This latter fact – imperfectly informed suppliers or brokers of capital - may be the reason for why even interest differences between equity and debt can be regarded as "capital market imperfections".

Especially small firms often have a more restricted capital endowment (Müller 2003). When they are obliged to participate in a system of tradable allowances, the possibility of less investment than predicted by „optimal“ marginal abatement cost considerations can not be ruled out entirely.

Figure 1 enables us to illustrate how large the capital constraint effects must be to eliminate the marginal advantage of plant Z: when the differences in capital interest costs exceed the difference in marginal production costs, the new plant can not compete even though it is more efficient “on its own grounds”.

d) Real option valuation

Yet another reason for supposing that investment decisions are different when new emitters must purchase allowances is given by Lambie (2002), who suggests that firms who have to buy allowances, rather than receiving them for free, have a larger financial „exposure“ and thus show a stronger tendency to *postpone* risky investments. He suggests that this phenomenon, termed “real option valuation” because the possibility to invest is an option that is lost at the very moment the investment is made, applies to potential new emitters as well. In other words, investments may be made later - which does not say much about the total investment over a given long-term time *span*, but explains less investment at a given *point in time* in the near future. To the extent that investment generates learning effects or other scale effects for new, advanced technologies, the above-mentioned postponement effect would also predict less long-term investment and/or slower technical progress.

In fact, real option valuation can play a role for the incumbent emitters’ incentives, too: With reference to Dixit/Pindyck (1994: 14f.) and Trigeorgis (1995) one can also think of an incumbent emitter who could obtain surplus allowances to sell by closing his old installation. But because of the real option value of keeping the installation operational – he might still benefit from it if some economic variables change and make it profitable again – he assigns a lower individual „opportunity cost“ of keeping his installation than he would do under certainty. So, he would require a higher allowance price (and, therefore, efficiency “advantage” of competing new installations – before he agreed to shut down and sell the allowances. Both effects increase with the allowance price volatility.

e) Market dynamics

As a last aspect, it is worthwhile to point out why it might be important that new firms enter the market, and not only incumbent emitters replace their old installations by own new ones. Apart from the arguments by Geroski and Ashford stated above that new entrants are important drivers of innovations, a further possible answer can be seen in the proposition that with a facilitated market entry for new firms, market dynamics and competition for the incumbent firms gain new momentum, and this may also lead to more innovative changes (see Röpke 1980, referring to von Hayek 1968).

2.3 Interdependence with rules for plant shutdowns and "leakage effects"

If, to avoid the above-mentioned problems, new installations are granted free allocation[5], then plants that shut down to be replaced by a new firm must be taken away their allowances. If this would not be done, a firm replacing a plant would receive allowances for its new installation but keep the allowances for her old one and thus get an "over-allocation". Therefore, giving out free allowances to new entrants requires at least a threat and a procedure to withdraw allowances from plants that are replaced (or shut down).

Similarly, rules that foresee withdrawal of allowances upon plant closure make free allocation to new installations much more important, since without them, there would be substantially lower incentives for plant replacement.

A second case for allowance cancellation upon plant closure is the issue of leakage and "shutdown credits": there are political (distributional), and often also efficiency related reasons for introducing a withdrawal rule. When firms reduce production or shut down a plant, they do not require the corresponding allowances for compliance any more and can sell them. As noted above, the monetary value of this option means opportunity costs of keeping a plant in operation. However, when a tradable allowance policy does not cover the whole area relevant for welfare from the regulator's perspective, then so called "leakage-effects" can occur: firms that close down plants can erect them newly in a country without a similarly stringent policy, and re-import the products. They will thus incur the revenues from the "freed" allowances and need not pay accordingly in the new "host" country. Under climate policy, for example, these "leakage" effects mean that global emissions are not reduced as much as the amount of "freed allowances" is increased in the former host country, making the targeted emission reductions unachievable. Global emissions may even rise, for example, when the new host country has no regulation in place at all. In addition, the employment and tax revenue effects to the country where the shutdown occurs have to be taken into account (Johnstone 1998: 30). The problem exists not only for global pollutants like CO_2: Also under primarily regional pollutants such as SO_2, leakage can mean a welfare loss to the country where the shutdown occurs, namely if transboundary air pollution exists or if depletable natural resources that are, in the long run, important for global welfare are damaged.

In fact, such a "shutdown credit" is even an *additional incentive* for closing down a plant and set up a new one in area without comparable regulation (Johnstone 1998: 29). This additional incentive is an issue only under market-based environmental policy instruments such as tradable allowances or taxes[6], since these assign a price

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[5] And plants – not companies – are the regulation level.

[6] Leakage is an under freely allocated, as well as auctioned, allowances.

(or opportunity cost) also to the remaining emissions after abatement ("inframarginal emissions"), and not only to the costs of abatement, as command-and-control policies do (see ibid.). For this reason, it may be suggested to withdraw allowances from plant operators when they shut down a plant.

A shutdown rule involves several new problems: One is that the rule can be circumvented by keeping a facility formally in operation just to retain the allowances. A further complication is that a plant *extension* investment is usually not qualitatively different from a new plant and should therefore be treated equally to avoid unequal treatment and allocation distortions (Hahn et al. 2003: 36f.). Likewise, down-sizings of capacity would have to lead to a corresponding cancellation of allowances (ibid.). While this seems, in principle, possible, it does create new administrative burdens.

We will treat the issue of new entrants jointly with that of shutdowns in the following analysis, as they can not be analysed separately. Furthermore, treatment of new entrants hereafter always includes plant extensions, and shutdown rules include down-sizings.

2.4 „Secondary effects" on incumbents and new emitters

When deciding on the feasibility of new entrants and shutdown rules, it must be kept in mind that tying free allowance allocation to erecting new production capacity, and withdrawing allowances from capacity shutdowns, is likely to have "secondary", or indirect, effects. Two of them are presented in this section.

a) Effects on the allowance price

Graichen/Requate (2003: 19f.) point out that the free allocation of allowances to new installations and capacity extensions, as well as withdrawal rules for shutdowns, lead to economic efficiency losses. This is since increases in production that are associated with new installations or capacity extensions lead to a higher individual allocation, while production reductions associated with plant shutdowns are "penalised" because of the allowance forfeiture. Thereby, an implicit production subsidy is granted. As a result, one means of reducing emissions – reducing the production of those products whose manufacturing causes emissions – is in these cases treated differently from all other abatement options (such as direct emission control, or efficiency measures): the incentives resulting from reduced emissions by reducing production are offset by the impact of higher individual production on the individual allocation. From an economic point of view, these options should instead be motivated to the same extent as all other abatement options.[7] Although not

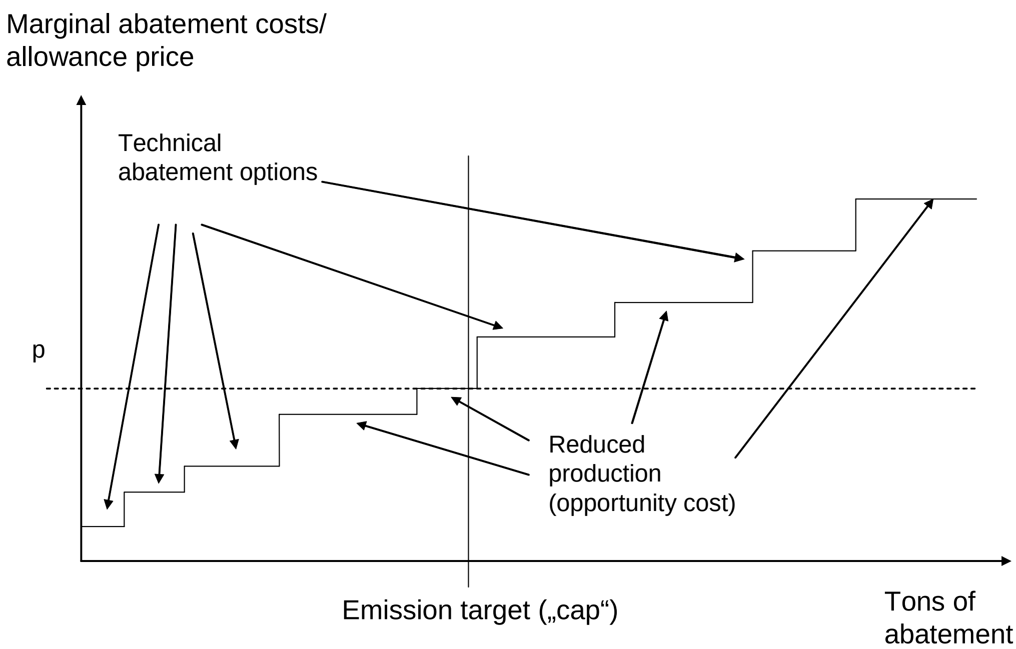
[7] From the argument given by Graichen/Requate (2003) it also follows that tying allocation to capacity changes of any kind means a distortion of static efficiency, since changes in *capacity* lead to additional allocation to the individual firm in question, while increases in *utilisation* of existing capacity do not lead to changes in the allocation. This creates an extra incentive for capacity increases over increases in the capacity utilisation rate – two actions that should be treated equally instead.

mentioned explicitly, Graichen/Requate's suggestion must be based on the following arguments.[8]

The products whose production leads to emissions are assigned a certain utility by consumers or have a certain productivity as intermediate products. Therefore, the marginal utility or marginal productivity that is foregone when incremental units of the product are not manufactured, has to be compared with the marginal abatement costs of those measures that reduce the ratio of emissions per unit of product.

In this perception, the marginal social opportunity cost of these products can be treated as any other abatement option, and plotted just as any other part of a firm's - or the social - marginal abatement cost function for a certain product. Each step on the curve that is related to production reductions resembles a certain type of use of the product, with its associated social value that is foregone when this "abatement option" is chosen. This is illustrated in figure 3a below.[9]

Figure 2a: Marginal firm/social abatement cost curve



Source: Own illustration.

Under free allocation to new installations/capacity extensions and forfeiture (withdrawal) rules for shutdowns, economic actors will value *some* of these production reductions – namely, those that lead to shutdowns or to the decision not to build a new installation – much higher, since, in addition to the market value of

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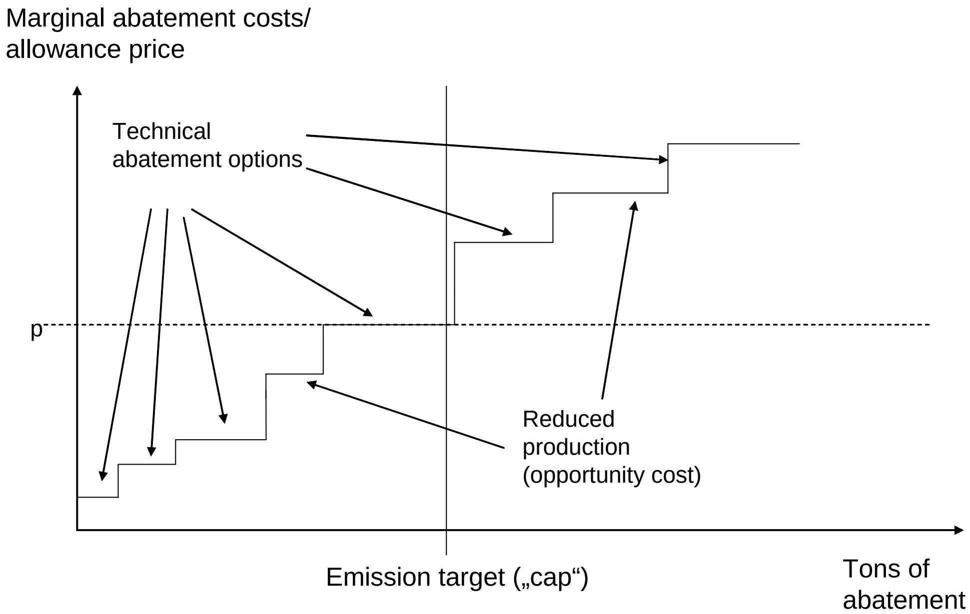
8 Graichen/Requate (2003: 19f.), referring to Spulber (1985), also point out that granting free allocation to new installations and withdrawing allowances form closed installations lead to an excessive level of firm entry and too little firm exit in the industry.

9 The abatement cost function could also be plotted for a product portfolio, in which different products have different associated revenues foregone, and possibly also different emission ratios. For the purpose of the general argument, the case of one product should suffice.

the product, also some amount of allocation is foregone. In other words, some of the abatement options are assigned higher costs, and they are shifted to the right side of the marginal abatement cost curve. This is illustrated in figure 3b.

Figure 3b: Marginal abatement cost curve with free allocation to new installations/capacity extensions, and forfeiture rules for shutdowns



Source: Own illustration.

It becomes clear that for any given emission reduction target, social costs are higher now, and so is the allowance price, since the remaining technical and production reduction measures alone have to make up for the required emission reductions.

What will be the innovation effect of this increased allowance price and the higher costs to reach the environmental target? The direct effect is clear: an increased allowance price leads to adoption of some advanced technology that is not profitable under a lower allowance price; and it is likely to lead to augmented R&D efforts as well. However, Grubb and Ulph (2002: 95f.) describe also a second, and negative, “indirect” effect on R&D incentives. It results from the fact that the increased emissions price in most cases (details see ibid.) also raises product unit costs, thus reducing the profits earned with the respective products, and thereby reducing incentives for R&D - less output means smaller aggregate savings in abatement costs that can be achieved through successful R&D. Grubb and Ulph suggest that the overall impact of an emissions price increase on R&D incentives is ambiguous (ibid.). This result is plausible also for the incentives to adopt advanced technology that was introduced by another firm, and thus for the diffusion rate.

The combination of the decreased production incentives in general (resulting from higher “emission costs”) on the one hand and, at the same time, intensified incentives to build new installations and avoid closures, intensify the distortions between changes in utilisation and changes in production capacity. Furthermore, it may well be that the effects are unevenly distributed across industry sectors: some firms in certain industry sectors may close down because of allowance price increases and in spite of the new entrants and shutdown rules, while in other industry sectors the new entrants rule or the shutdown rule dominates the effect of the increased emission costs, and thus leads to a “net” production-increasing effect in these sectors. This latter point depends, in part, on the price elasticities of demand in the various industries *simultaneously* covered by a system of tradable allowances (these elasticities depend, in turn, in part on the degree of foreign competition).

b) Effects on firm size distribution and market concentration

Granting free allocation to new installations can favour larger firms compared to smaller ones. This is due to the possibility of strategic plant utilisation which larger firm have to a greater extent than smaller firms. When installing a new plant or a capacity extension results in an additional allocation, and the allowance price is high enough to render emission costs a relevant cost factor, then it may pay out to build new installations and simultaneously reduce existing installations’ output, but still keep them formally in operation. As long as future allocation to existing plants is based entirely on *past* emissions or production output - and not on *current* emissions as well -, the allocation to existing plants remains unchanged in spite of the reduced activity in these plants, while the new production in the new installations “yields” additional allowance allocations. This strategy is much easier to perform for larger firms with several installations, due to indivisibilities in production. (It is also much easier to undertake in electricity production than in many other industry sectors, since boilers can be run economically profitable at different utilisation levels, and plants are often composed of several boilers.)

The increased allocation to large firms leads to reduced allocation to all other firms, since the cap is fixed. As a result, since relatively more larger firms are favoured and comparatively more smaller firms disfavoured, this rule exerts, over time, a tendency towards higher market concentration. Whether this effect is strong, and moreover, what is the impact of higher market concentration on innovation, is a very complex issue that can not be discussed in all detail in this paper. After all, empirical studies have found very heterogeneous results on the link between market concentration and innovation (see Schwitalla 1993 and Jaffe/Newell/Stavins 2000), with a slight dominance of empirical evidence indicating that less market concentration is more favourable to innovation.

3. The institutional design: comparing different alternatives for new entrant rules

3.1 Overview of the available alternatives

There are several alternatives to deal with new entrants:

a) not assign any allowances to new entrants and let them buy the required allowances on the market;
b) not issue free allowances to new installations but "convert" the new installations to a treatment as existing installations after a defined period (for example, five years.)[10];
c) assign allowances immediately to the new entrants when they start operating. In this case, a reserve must be kept for the new entrants.

Even if a decision for one of the three options has been taken, there are still different options in detail. Under a), it is possible to keep a % reserve for new entrants but still treat the incumbent firms as the "owners" of all 100% of the allowances. This has been applied under the Acid Rain Program (ARP): 2.8% of all allowances are held back and auctioned off – to all firms who bid, not only new entrants. The important issue is that the revenues do not go to the state but are "recycled" to the incumbent firms (Hansjürgens 1998).

When choosing c), several variants are possible. The first differentiation concerns the mode of allocation to the new entrants:

- c1) The allowances are periodically auctioned off to the new entrants but the revenues are kept by the regulator (thereby distinguishing it from the ARP procedure),
- c2) The allowances are given out freely to the new entrants.

In the latter case, a formula must be found for *how many* allowances each new entrant receives:

c2i) as many as the individual new entrant needs,

c2ii) as many as an average firm would need ("average-based benchmark"),

c2iii) as many as needed when applying the "Best Available Technology" (BAT).

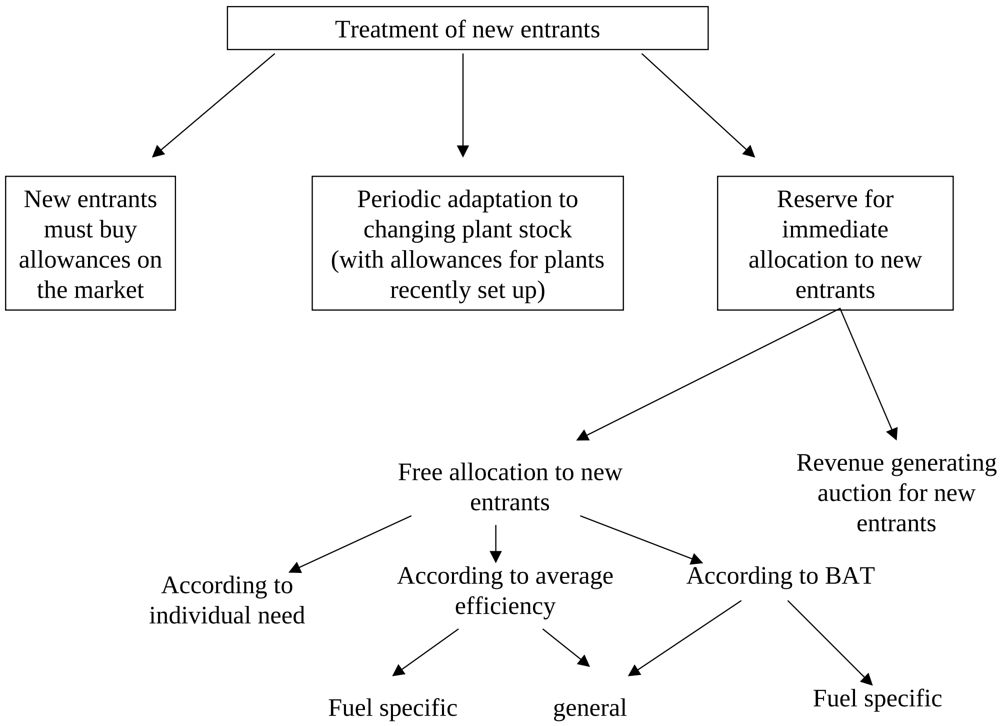
(see DIW/Öko-Institut/Fraunhofer-ISI 2003: 25).

Furthermore, how big should the reserve be? If it is small, then it must be used up on a first-come-first-serve basis, as applied in the RECLAIM program (see Bader 2000: 91), or it must be split proportionally among applicants, as done in the Czech Republic and Hungarian allocation rules 2005-2007 under the EU-ETS for CO_2 (see DEHSt 2005). Alternatively, an "open" reserve can be set up by means of an

[10] This period would ideally be tailored to the general "allocation periods" for existing firms – for instance, under the EU-ETS for CO_2, Member States allocation rules for all installations may be changed every five years, see European Union (2003).

obligation for the government to "step in" when the reserve is exhausted, and purchase additional allowances on the market which are then assigned for free to any further new installations (thereby maintaining the overall cap). This approach has been applied in the German allocation rule for 2005-2007 under the EU-ETS for CO_2 (DEHSt 2005). As a third alternative, one can make the reserve large enough so that every firm receives enough allowances. This increases the likelihood that the reserve will not be used up. In this case, a further question is how to proceed with a potential unused remainder in years where the reserve is not used up. Will it be assigned proportionally for free to the incumbent firms or will it be auctioned?

Figure 3: Overview of allocation approaches to new emitters



Source. Own illustration.

We will not deal with all these questions here, but pick those that appear most relevant to the technology choice of a potential new entrant or a firm considering a plant replacement.

3.2 Evaluation of the alternatives

This chapter first compares the general alternatives a) through c) with each other. Then it discusses the pro's and con's of the different possible variants for free allocation to new installations (alternatives c2 i) through iii)). This includes also potential rules for the transfer of allowances from closed plants to new plants. Finally, a subchapter deals with the question of potential discrimination between different types of innovative investments.

3.2.1 General comparison of the alternatives b) and c)

The choice between alternative a) (new entrants must buy allowances on the market) and the other two alternatives is essentially the matter of chapter 2, and the alternative a) is presented in this chapter merely for illustration purposes.

Alternative b) can potentially combine the advantages of option a) (easy to handle, no "picking of winners", see below) and c) (no permanent financial disadvantage for new actors in the market). However, also option b) has two potential drawbacks: first, it can create incentives to construct new plants rather immediately before a date at which all recent new installations are "taken stock" by the regulator and receive allocations for the first time, rather than erecting it at any other date. Likewise, shutdowns would be placed best at immediately after a date at which the regulator takes stock, since then the owner can keep the allowances all the period until the next time at which the regulator takes stock. This can lead to allocation distortions (DIW/Öko-Institut/Fraunhofer-ISI 2003: 24). Furthermore, treating all new installations as existing installations after every few years is especially problematic for efficiency incentives in the new plants when existing installations are allocated according to grandfathering based on absolute past emissions: Then, owners of new plants must expect to receive more allocation in the future when they build a less efficient new plant, and this reduces exactly the emission reduction incentives that tradable allowances would "normally" create (for example, under alternative a)).[11] Therefore it is suggested that even if all "old" existing plants are allocated according to absolute past emissions, and option b) is chosen, new installations should still be treated differently from the „old“ existing plants. For example, they could be allocated according to an efficiency benchmark denominated as emissions per capacity unit, or per unit of product output.[12]

Alternative c), which allocates allowances to the new installations immediately at the start of their operation, can, as mentioned above, be important especially in cases of frictions in the allowance markets or if capital restrictions are a relevant issue.[13] However, also under this rule the regulator is faced with the question of how to treat new installations after the first few years: will every new emitter

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[11] This effect is, however, ameliorated by the influence of the discount rate: higher emissions of the new plant in the first years lead to higher purchases of allowances, while the higher allocation in the future years must be discounted and is thus valued less (see Cames/Weidlich 2003). Nevertheless, if the treatment as an existing plant is granted for much longer than the initial period in which no allocation is granted, then the mere relative length of the periods may dominate the effect of the discount rate.

[12] This would not create disincentives for higher efficiency, and create „only“ incentives for „too much“ capacity or "too much" production.

[13] In the RECLAIM program in California, free allowances are allocated only to those new emitters who have a low ratio of emissions and employment („High Employment-Low Emissions"/"HILO"-companies, see Bader 2000: 91). Also this can set an incentive to use very efficient new technology - although the main effect is to attract firms from *sectors* that are inherently employment-intensive rather than emission-intensive, see ibid.).

receive permanently the allocation it receives in the first years – which is usually lower than the allocation for existing emitters - or will she be treated as an incumbent emitter at some point in time?

The answer to the question as to which time horizon is more conducive to innovation depends, first, on the incentives for new emitters, which in turn depend on the allocation to new emitters, compared to the allocation to existing firms.

Secondly, the answer depends on the situation for the incumbent emitters. The larger is the reserve for an immediate allocation to new emitters, the less allowances can be granted to the incumbent emitters, since the overall cap is fixed. If the unused part of the reserve is given back to the incumbents, an oversized reserve does not necessarily result in less allocation to the incumbents, but it augments the uncertainty for the incumbents regarding how many allowances they will own at the end of the compliance period (this was also suggested by Tennesse Valley Authority (TVA), one of the largest participants under the US Acid Rain Program, in an interview on 29 July 2004). If, in contrast, any remaining part of the reserve is auctioned off and the revenues accrue to the state, incumbents receive less allowances for free, but they have no additional uncertainty compared to alternative a) resulting from the unknown size of the reserve remainder (they face additional uncertainty, though, about the costs of the additional allowances they may need.).

3.2.2 What should be the allocation basis under alternative c) ?

General rather than individual allocation formulae

Here, a first clear vote from an economic perspective must be that the allocation should *not* be directly derived from the individual emission need of the new plant, since such a rule would mean higher allocations for less efficient plants, eliminating the incentives from internalisation. Instead, a benchmark should be applied. This can be based either on an emission rate (emissions per product output) as derived from “Best Available Technology” (BAT) standards. Alternatively, it can be based on a national average of all firms’ emissions rate (per product output or per capacity).[14] In nearly all cases, allocation to new installations is higher under average based benchmarks.

BAT versus average benchmarks

The choice for either a BAT or an average based benchmark is important regarding criterion 1 as stated in the introduction: Not surprisingly, average based benchmarks generate higher incentives to build new facilities, since the „reward“ for building

[14] BAT based benchmarks for the allocation to new installations were applied in the first National Allocation Plans of many EU Member States, such as Germany, the UK, Denmark etc., under the CO_2 emissions trading scheme, see DEHSt 2005). In contrast, allocation oriented at average based benchmarks for new installations was applied, for example, by France.

them, in terms of allocation, is higher. This applies, in general, irrespective of the question whether a withdrawal rule for closed plants is applied or not.[15,16]

In contrast, the choice between benchmarks based on BAT or average values is, in general, irrelevant for the results concerning criterion 2, namely, for how advanced versions of any given technology the investors will purchase. This is because also here the opportunity cost principle applies: when a BAT benchmark is chosen, firms with a very advanced installation must purchase fewer allowances; when an average based benchmark is chosen, firms with a very advanced installation will have more allowances to sell. The gains from choosing the advanced investment are the same under both rules.[17] The difference between average and BAT benchmarks can, however, be relevant for criterion 3, the choice between different advanced technology "paths". This is described in section 3.2.3.

Transfer rules

Even with new entrant allocation according to benchmarks, the incentives for plant replacement are lower under alternative c) than under a) if in conjunction with alternative c) a shutdown withdrawal rule is applied. Recall that such a shutdown rule is usually deemed necessary if new entrants shall receive free allocation and "double-allocation" allocation is to be avoided. Combining free allocation to new entrants with shutdown withdrawal rules lead to lower investment incentives than

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15 This incentive can even be higher than optimal from a static allocation perspective, since „too many" new installations may be erected (see Graichen/Requate 2003 and the argument in chapter 5, "secondary effects"). Whether "too many new installations" also lead to "too much" *innovation* - in terms of comparing the cost savings by innovation with the necessary investments and "crowding out" effects regarding non-environmental innovation - is an issue that depends on whether one regards the actual internalisation policy as "optimal", "superoptimal" (socially inefficiently high environmental standards) or "suboptimal" (socially insufficient environmental standards). Considerations of public choice theory, which lends support to the belief that internalisation is rather suboptimal, would suggest that "too many" new entrants from a static allocation perspective may still go in line with optimal or even suboptimal innovation rates. The same proposition can be supported when acknowledging potential "spillover problems" for innovations, which reduce incentives for innovation.

16 Following the argument in chapter 2 that free allocation to new emitters without an effective withdrawal rule for shutdowns leads to "systematic double allocations" that favour larger firms in the long run, it must be concluded that this "concentration effect" applies to a higher degree to average benchmarks than to BAT based benchmarks.

17 Experience with BAT suggests that because BAT references are taken from industry standards, industry representatives learn to anticipate that their own efficiency progress may lead to tightened BAT standards in the future, thereby reducing the incentives for efficiency improvements (in Germany, this has been labelled the "cartel of tacitness among the senior engineers", who, in order to avoid tightened environmental standards, are careful not to announce, or even apply, all technical advances that are possible). The question is how effective such "perverse" incentives would be under emissions trading with many participants, not least since the gains from applying advanced emission reduction options are usually assumed to be higher under tradable allowance policies than under "command-and-control" policies.

not applying these rules[18], since normally the replaced plant will have higher emissions - and correspondingly receive a higher allocation when allocated according to grandfathering – than the replacing new installation.

This incentive problem that results primarily from the shutdown forfeiture rule can be (at least) ameliorated by a so-called „transfer rule“ (DIW/Öko-Institut/Fraunhofer-ISI 2003: 26f., Cames/Weidlich 2003: 12): Firms replacing an old facility are permitted to choose if they want to transfer the old installation's allocation to the new installation. With such a rule, any emission reduction achieved through the plant replacement is rewarded to the same extent as would be the case under alternative a) without a withdrawal rule. The next question, then, is for how many years the transfer rule should be available to a firm.[19]

Transfer rules imply rents for the incumbent firms that are not granted to the new emitters. In this respect, they share a part of the problem associated with not granting any free allowances to new emitters, but to a lesser extent, since with a transfer rule, the owners of new installations can receive at least an allocation in the amount of, e.g., BAT or average benchmark allocation.).

Furthermore, if the transfer is allowed only between installations of the same firm, then this would mean market distortions in favour of replacing a closed installation with an “own” installation, rather than closing it and have it replaced by a foreign firm's installation. If, instead, the transfers could also be done between installations of different firms, it may be more profitable to close a plant and sell the “transfer right” to another firm. The other firm would be willing to pay the price for these “transfer rights” if their own plant was indeed more emission efficient – thereby leading to allocation efficiency between different potential new installations. Germany's National Allocation Plan for 2005-2007 under the EU CO_2 trading scheme therefore foresees a transfer rule that can also be used between different firms from the same industry sector (see DEHSt 2005).

A transfer rule of this form would nevertheless not eliminate much of the leakage effects. At least, it reduces the adverse employment effects, since a firm can secure shutdown-credits only if it finds a replacing firm in the same regulation area. But the emission leakage – meaning higher emissions in countries without regulation

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18 At this point we abstract from “leakage” in order to separate the arguments.

19 A second issue with a transfer rule is its validity across borders if different regulators are involved: In tradable allowance schemes where the different regulatory bodies (e.g., states) have some degree of freedom in choosing their allocation rule – as in the OTC/SIP-call NO_x trading in the USA (see Harrison/Radov 2002) and in the EU-ETS for CO_2 – some regulators may apply a transfer rule and some may not. If, then, firms can use the transfer rule only for domestic installations in the country in which the shutdown occurs, this may create a decision bias for new installations in favour of domestic investments. If a foreign country would be chosen, the old plant's allowances would be withdrawn and the replacing installation would receive only as many allowances as new installations receive in the country of choice. This issue points to the general problem of potential geographic misallocations when different regulators apply different rules for new emitters and plant closures. .

without a compensating additional emission reduction effect in the allowance trading system - can hardly be avoided by means of such a rule. This becomes clear when keeping in mind that under a transfer rule, the spare allowances from the shutdown credits do not leave the allowance trading system and therefore do not reduce the overall cap. A part of them accrues to the replacing unit, which otherwise would buy allowances on the market or would be served from a reserve; and the remainder – the difference between the new installation's "needs" and the old installations' allocation – are spare allowances that can be sold on the market.

Equal allocation to new and incumbent installations

A potential alternative could be a completely equal treatment of old and new installations by allocating to both firm groups according to production-output based benchmarks. This can be directly applied only if benchmarking is chosen as the general allocation method for incumbents, too. Nevertheless, also under grandfathering for incumbents, at least a comparable treatment is possible: An allocation for new installations based on average benchmarks as mentioned above results, on aggregate, in allocations comparable to the allocation for incumbents.

3.2.3 Potential discriminations among different technologies

We have postulated above that a potential new emitters rule must not lead to a discrimination among different technologies, because this would create an „uneven playing field" for the competition among them, and potentially "pick winners" of which some would not have been the most cost-efficient in the long run. Picking winners is particularly problematic in the light of Hayek's proposal that the government can hardly ever have better information than what all market participants together, mediated by free markets, can have. Therefore, as much choice as possible in any particular situation should be left to the private agents.

a) ...among different fossil fuel based technologies: choice of benchmarks

From an innovation perspective as just mentioned, applying allocation benchmarks that are differentiated by technology (for example, the type of fossil fuel used) in general can not be recommended since it interferes with private agents' decisions. They are recommendable from such an innovation perspective only if some technologies have a superior long-term cost reduction potential, but some other, (in the long run inferior) technologies are likely to have a "head-start" because of „lock-in-effects" such as economies of scale, learning effects or infrastructure advantages (see Arthur 1989). If these lock-in effects would threaten to prevent the superior technologies' market entry for a significant time and this peril can be demonstrated without much ambiguity, then there would be scope for deliberately applying differentiated benchmarks for some technologies, in this case in order to "*keep* the playing field even". For example, one could argue for a higher benchmark for coal fired power plants *if* one expects the bulk of long-term efficient electricity production to be from coal *and* these long-term cost savings would be expected to outweigh the short- to mid-term cost savings from competing gas-fired plants, *and* the latter would indeed get an unjustified head-start under uniform benchmarks for new emitters. One argument for this belief could be used when great hope is assigned to innovation in carbon capture from the stacks and its subsequent sequestration, *and* the expected cost-savings through this innovation would make coal a more cost-efficient generation technology in the long-run.[20] Only in such – potentially few – cases where lock-in-effects are indeed realistic, technology differentiated benchmarks appear to be viable from an innovation perspective.

Concerning the choice between BAT and average values, from a political perspective it appears to be easier to argue for uniform average benchmarks than for uniform BAT benchmarks, not least since traditionally BAT values have often been fairly differentiated even between similar technologies (see, for example, the “BREF” documents under the “Sevilla Process” of the European Union).

b)…between fossil fuel based and renewable energy sources

This issue appears to be frequently overlooked in discussions on the innovation effects of new emitters’ allocation rules; the only source known to the author is Graichen/Requate (2003: 14f). If fossil fuel based plants are assigned allowances with some reference to their emissions, then there is discrimination against new renewable energy sources („RES“), since their owners usually do not have the right to receive free allowance allocations. In other words, at least a part of the internalisation of the external costs is given up, as it pays off for a firm to build a fossil fuel based plant due to the allocation it will receive. This will matter especially in the long-run, when “carbon costs” increase. The distortion is, in the view of this author, even higher under average benchmarks than under BAT benchmarks for new emitters.

Also, a shutdown withdrawal rule leads to a lack of incentives for replacing fossil fuel based plants by RES installations, if new RES do not receive allowances. Also this constitutes a subsidy for fossil fuel based plants (Graichen/Requate 2003: 15).

As a consequence, if free allocation to new installations and withdrawal of allowances for closed plants are applied, then free allowances should not only be assigned to fossil fuel based new plants, but also to new RES installations, thereby preventing preservation of the fossil fuel based energy structure. If allocations to fossil fuel based new emitters are differentiated according to fuels, RES should receive at least an intermediate fossil fuel benchmark. Also for the transfer rule, an RES replacing a fossil fuel based plant should be eligible to receive the allowances from the old plant.

[20] All these arguments would have to incorporate expected fuel prices for gas and coal, respectively.

c)…between different products

If benchmarks are differentiated according to the final products – an issue relevant in industry sectors such as steel, glass, or paper – then also the incentives for changes in the *product range* are eliminated as far as new capacity is concerned.

4. The interplay of new entrant and shutdown rules with the allocation to incumbent emitters: grandfathering versus benchmarking

This text deals primarily with the potential impacts of different provisions for new installations and plant shutdowns. However, as the difference between auctioning and free allocation indicates, also the general allocation rules for the existing installations can influence the incentives for plant replacement. In this chapter, we therefore compare the incentives resulting from grandfathering based on a plant's historic emissions, and benchmarking based on a plant's historic production output. We concentrate on the incentives for replacement resulting from the allocation to the "old" plant, which at the time of writing have not been published in any work known to this author. Another issue, not covered here, are the incentives resulting from the expected allocation to new entrants in the long run, e.g., after they have been "transferred" to treatment as incumbents.

As ENTEC/NERA (2005) note, benchmarking has a different impact on the actors' decisions compared to grandfathering *whenever* there is an element of "updating" in the allocation process, meaning that a firm's actions can, in any way, influence its own future allocations.

The provisions for new entrants and plant shutdowns lead to such an effect, since in case of a plant shutdown, the allocation granted to the old installation is lost, while the allocation to the replacing installation is gained (including the possibility of a transfer rule, where the new installation temporarily receives as many allowances as the old one received).

As a rule, an actor possessing several installations and considering replacement of some of them is likely to choose some of his oldest installations as the first ones to be replaced. Under grandfathering, he therefore looses an amount in close proximity to the old plant's individual emissions - say, for example, corresponding to 1000 g CO_2 per kWh of electricity produced under CO_2 emissions trading, if the plant to be closed is an old hard coal power plant, and the trading system is in its first implementation years, meaning only modestly stringent emission reduction targets.

In contrast, under benchmarking each plant receives only as many allowances as is the average (or even "best in class") emission efficiency of installations in the respective installation class - here, for instance, hard coal power plants (when "fuel-specific" benchmarks are applied), or all power plants in general. Under fuel-specific benchmarks, an old hard coal power plant would then only receive, for instance, 900g CO_2/kWh.

For each year that replacement is postponed, a firm under grandfathering therefore retains an allocation of 1000g/kWh, while under benchmarking it retains only 900g/kWh. As a result, incentives for postponing the closure of an old plant are higher under grandfathering. The difference is even bigger when compared to a benchmarking approach in which all power plants are averaged: In this case, the benchmark may only be, for example, 750g.

This result is, in absolute terms, independent of how many allowances are granted for a new plant. (However, the relative importance of the difference between grandfathering and benchmarking, compared to the allocation "gap" between the allocation for the existing and new plant, would be larger if new plants are granted higher allocations.)

The picture changes, however, in the case of a transfer rule. In this case, both grandfathering and benchmarking offer the same replacement incentives during the period in which the transfer rule can be used. This can be illustrated by means of the same example figures as used above: Under grandfathering for existing plants, a plant owner would receive 1000g/kWh (and need that much to cover her emissions) if she retained the old plant. If she opted for replacement instead, she would receive 1000g/kWh for the duration of the transfer eligibility period, but need only the emissions amount of the new plant (for example, 750g/kWh). The incentive would be 250g/kWh more allowances to sell in case of replacement. Under benchmarking, she would receive 900g/kWh but need 1000g/kWh when retaining the old plant, and receive 900g/kWh but need 750 g/kWh when replacing the old plant. The incentive to replace is then 100g/kWh of purchases saved, and 150g/kWh allowances to sell, which is the same as the 250g/kWh to sell that accrue under grandfathering. As a result, when abstracting form capital imperfections, grandfathering and benchmarking offer the same incentives under a transfer rule as long as the transfer eligibility period is long enough (for instance, 10 years) so that the discounted value of the difference occurring after that period is negligible (or the old plant would have been replaced by then anyway).

Concluding, one can state that if grandfathering is chosen for the allocation to existing plants, it is of higher importance to introduce a transfer rule – with sufficient eligibility times – than it would be under benchmarking. Conversely, if the transfer rule is designed only short-term or not desired at all (for example, due to distributional and/or market power considerations), then benchmarking should clearly be favoured from the perspective of plant replacement incentives.

5. Application in existing tradable allowance systems

This section presents the treatment of new installations/capacity extensions and plant closures in the most prominent existing allowance trading schemes in the USA (section 4.1) and Europe (section 4.2).

5.1 New entrant and shutdown rules in US emissions trading programmes

In general, the US trading programmes can be said to adhere very much to the principle of a "once-and-for-all" fixed allocation; much more than is the case in the EU-ETS for CO_2. As noted in the chapters before, a "once-and-for-all" allocation without any new entrant and closure rules is the most efficient way of allocating allowances (apart from auctioning), as long as no substantial leakage effects, capital constraints or market power issues exist and as long as firms generally operate according to marginal cost principles.

Since all US programmes mentioned here cover rather "local" or national pollutants, leakage is not as central an issue as it is with global pollutants like CO_2 (although Johnson and Pekelney (1996) suggest on the basis of empirical data that job effects from leakage do matter in RECLAIM in the Los Angeles basin).[21]

As a result of this "once-.and-for-all" allocation approach, the two most prominent programmes up to now, the Acid Rain Program and RECLAIM both do not provide for a general free allocation to new entrants – although both provide some means of "access" to new entrants, since the fear of investment barriers could apparently not be ruled out completely.

Under the "OTC (Ozone Transport Commission) NO_x Budget Program" in several north-eastern US states (see Harrison/Radov 2002: 41f.), the decision on allocation rules was, in principle, left to each participating state. Some of the states, such as Massachusetts, provide free allocation to new entrants from a limited reserve (here: 5%). An allocation proposal set up in 1999 by the US federal environmental agency EPA (Environmental Protection Agency), to support its planned "SIP call" for NO_x trading in the whole eastern USA, which replaced the OTC NO_x Budget Program, also foresees such a new entrant reserve USA (see Harrison/Radov 2002: 45).

In RECLAIM, and in Massachusetts under the NO_x Budget Program, allocation to new installations is in principle based on benchmarks per unit of output. Under the EPA proposal, in contrast, allocation is heat input times a default emission factor.

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21 It will therefore be interesting to see what approach will be used in the planned "Regional Greenhouse Gas Initiative" (RGGI) trading scheme among north-eastern US states, since there leakage may be more of an issue.

This rule, when applied to new entrants, eliminates the incentives for erecting a very efficient plant and "rewards" only the choice for a low-emission fuel.

None of these schemes is known to apply shutdown withdrawal, or transfer rules.

Table 1a: Rules for new installations and shutdowns under the US emissions trading programmes

	Free allocation to new entrants? Reserve size as % of national cap; limited or unlimited reserve?	Allowance withdrawal in case of shutdowns ?	Allocation metric for new entrants	Fuel differen-tiation?	Transfer rule?
Acid Rain Program	No (auction of 2.8 %, limited reserve)	No	-	-.	No
RECLAIM	No (exception: free allocation to "high-income-low-emissions" plants; limited reserve)	No	Benchmark for ratio of emissions per worker	n.i.	n.i.
OTC/ NOx Budget Trading Programme, here: Massachusetts	Yes (5 %, limited reserve)	n.i..	Benchmark per unit of product output	Yes	n.i.
NOx SIP-Call: allocation proposal by EPA	Yes (5 %, limited reserve)	n.i.	Individual heat input multiplied by a benchmark emission factor (emissions per heat input)	No	n.i.

Source: Own extraction from Hansjürgens (1998), Bader (2000) and Harrison/Radov (2002).

5.2 New entrant and shutdown rules in the EU-ETS

Similarly to the OTC NOx Budget Program and the SIP-Call, the EU-ETS allocation is implemented by each Member State, who also has considerable discretion in designing the allocation rules. The EU CO_2 Emissions Trading Directive (European Union 2003) sets, however, some limits to assure a certain degree of consistency and harmonisation, and to prevent extreme forms of a "race to the bottom" due to competition pressures between the Member States, among them the competition for attracting new facilities and the jobs associated.

All Member States (MS) but Sweden allocate free allowances to new entrants – in Sweden, only very efficient combined heat and power (CHP) installations and industrial installations receive free allowances.

The size of the "new entrant" reserve ranges from 0.6 % (Germany) to 26.3% (Malta) (DEHSt 2005: 11). Three aspects have to be kept in mind when comparing these figures: First, although the smallest nations in general have the relatively largest reserves, this can be understood in part by the fact that one large installation can "eat up" the entire reserve at once. Second, in those MS in which transfer rules are applied, and/or allowances withdrawn from closed plants are planned to fill up the reserve, the “real” reserve is larger than would be concluded from the percentage figures alone. Third, some MS distinguish between “known” and “unknown” new entrants and include only the latter in their reserve.

All MS apart from the Netherlands, and possibly Sweden, Latvia and Slovakia, withdraw allowances from closed operations. In most other MS the owner can keep the allowances issued for the year of closure, but does not receive any further allocations in the following years. The national allocation plans of several MS include shutdown rules which apply, for instance, if an installation’s production or emissions drop below 10% of the respective numbers in the base years. These rules may induce firms to produce just above this level, when a higher production is not profitable including opportunity cost.

The Dutch approach to shutdowns can be predicted to lead to stronger re-investment incentives than those of the other MS that withdraw allowances, since in the Netherlands an operator replacing an old plant retains the allowances of the old plant and in addition receives allowances for the new plant. This incentive may even be “overdone”, but in the light of the currently very modest level of internalisation of emission costs, this distortion may be justified. After all, the “real” primary distortion is the subsidy to any production increase associated with a new facility or a capacity extension, not this “double incentive” for replacement.

However, even in the Netherlands, a plant owner can hardly keep her allowances from a closed plant infinitely: This is because the EU-ETS shows a significant difference to, e.g., the Acid Rain Program, in that it ties a plant owner’s eligibility to receive allowances to the question whether the plant has a CO_2 “permit”, which means the right to continue emitting any CO_2 (see European Union 2003).[22] Such a permit is usually lost a few years after the plant’s closure, at the latest. Therefore, the “historical” principle is much stronger under the US emissions trading schemes even when EU Member States formally do not apply a shutdown withdrawal rule.

Most MS apply BAT benchmarks, only France is clearly known to apply far more generous benchmark values to new entrants, in an amount comparable to average emissions of existing and new plants together. One or two MS (Latvia and possibly Greece) apparently allocate according to the new installation’s prospective *individual* needs.

Fuel differentiated benchmarks are applied by roughly half the MS of which information is clear, at least for the public electricity/heat generation sector. The other MS with clear information apply no fuel differentiation in this sector.

At least ten MS apply transfer rules, of which several are restricted to installations owned by the same operator, however.

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[22] The use of the term “permit” as a *general* permission to operate a polluting plant – a use which is common in the USA as well – is the reason why only the term “allowances” is used in this paper for the tradable certificates denominated in emission amounts. Both permits and allowances are always temporary “property rights” granted by the regulator, and never infinite “rights”.

Table 2a: Rules for new installations and closures of the EU Member States under the EU-ETS

	Free allocation to new entrants? Reserve size as a percentage of national cap; limited or unlimited reserve	Allowance withdrawal in case of shutdown?	Allocation metric for new entrants	Fuel differen-tiation?	Transfer rule?
Austria	Yes (1.8 %, limited reserve)[23]	Yes	BAT	n.i..	Yes[24]
Belgium	Yes (4 %, limited reserve)[25]	Yes[3]	BAT	n.i.	n.i.
Cyprus	Yes (0.7 %)	n.i...	BAT	n.i.	n.i.
Czech Rep.	Yes (3.1 %, limited reserve)[26]	Yes	BAT	n.i.	No
Denmark	Yes (3 %, limited reserve)	Yes	BAT-comp.[27]	No	No
Estonia	Yes (3.4 %, limited reserve)	n.i.	BAT-comp.[28]	n.i.	n.i.
Finland	Yes (1.8 %)	Yes	BAT	Yes	Yes
France	Yes (1.7%, probably unlim.)[25]	Yes	Average	n.i.	Planned
Germany	Yes (0.6%, unlimited res.)[29]	Yes	BAT	Partly[30]	Yes[31] **[32]**
Greece	Yes (4.25%, limited reserve)	Yes	Indiv. need (?)	Yes	Yes[2]
Hungary	Yes (1.9 %, limited reserve)[22]	Yes	BAT	n.i.	Yes[10]
Ireland	Yes (1.5 %, limited reserve)	Yes	BAT	n.i.	No
Italy	Yes (16.7%, unlimited reserve) [25]	Yes	BAT	Not clear	Yes
Latvia	Yes (11.5 %, limited reserve)	Not decid.	Indiv. need	Yes	No
Lithuania	Yes (5 %, limited reserve)	n.i.	Benchmark[33]	n.i.	Yes[34]
Luxemburg	Yes (12 %, unlimited reserve) [25]	Yes	BAT	No	Yes[2]
Malta	Yes (26.3 %, limited reserve)	n.i.	BAT	n.i.	n.i.
Netherlands	Yes (2.6 %, limited reserve)	No[35]	BAT-comp.[36]	Yes	No
Poland	Yes (0.4 %, unlimited reserve)[25]	n.i.	BAT	Yes (?).	Yes
Portugal	Yes (8 %, limited reserve)	Yes	BAT	n.i.	Yes
Slovakia	Yes (2.3 %, limited reserve)	Not clear	BAT	n.i.	n.i.
Slovenia	Yes (0.8 %, limited reserve)	Yes	BAT	Yes (?)	Yes
Spain	Yes (3.6 %, limited reserve)	Yes	BAT	n.i.	No
Sweden	Only for industry + very efficient CHP (3.2 %, limited reserve)	Probably no	BAT	No	n.i.
U. K.	Yes (6.3 %, limited reserve)	Yes	BAT	No[37]	No

Source: Own extraction from DEHSt (2005).

23 Allowances not issued to closed installations are transferred to the reserve.

24 Restricted to transfers between installations of the same operator.

25 Information refers to Flanders; not clear for Wallonia and Brussels.

26 In the Czech Republic and Hungary the new entrants reserve is split into 3 annual parts, which are allocated proportionally among installations that went operational in the preceding year, see DEHSt (2005: 11).

27 Benchmarks as used in the Danish CO_2 tax system

28 Lowest specific emissions value for comparable technology as applied in Estonia in the preceding five years (DEHSt 2005: 40. classifies this rule as "average" oriented, a classification not shared by this author.)

29 When the reserve is exhausted, government must buy additional allowances on the market and allocate these to further new entrants, so that the cap is maintained.

30 No distinction between hard coal and lignite.

31 Open for transfers also between different operators

32 Transfers are valid only in the first trading period 2005-07 except for Germany and Hungary, where transfers are valid for 4 years.

33 Not clear if BAT or average.

34 For public electricity and heat only, application not sure

35 Most likely only during the same trading period (3 years or 5 years).

36 Benchmarks as derived from „world top 10%".

37 Allocation according to a CO_2–intensive fuel is possible under strict conditions – for instance, unavailability of low-emitting fuels must be proven by the operator.

6. Conclusions

The decision on whether rules for new entrants and shutdowns are necessary should, in the view of this author, at first depend on the issue of potential leakage effects. This is first because it can be suggested that the adverse welfare effects from leakage may in many instances outweigh even the welfare losses from reduced innovation. Secondly, leakage reduces the degree of internalisation (and the associated allowance price), which in itself is a central innovation factor - one whose importance for innovation seems at least comparable to that of potential distortions between different actors and different technologies. Finally, leakage can even imply free-rider problems between different nations or regions.

The welfare impacts of leakage issues, and therefore their dominance as an argument, depend first on how global, or at least transboundary, the associated external effects are (this may also include the issue of reversibility of damages, together with the normative issues of "global commons"). In this context, CO_2 is an "ideal" environmental problem to be solved by market-based instruments only when a significant share of its emissions can be internalised and if the free-rider problems are not significant. "Local" pollutants like NO_x may imply less potentials for cost savings when the cost-differences among actors are not as large as with CO_2, due to regional restrictions, but on the other hand they imply smaller environmental externalities from leakage. A second factor for the size of adverse leakage effects is the question of the degree of competition between areas with environmental regulation and those with none. This depends primarily on transport costs. For example, leakage is much less of an issue for electricity and heat generation than it is for steel or paper products, where markets are often international or even global.

The second central criterion for the necessity of special new entrant and shutdown rules is whether market power is a critical issue or whether the differences in economic rents associated with pure "historic" allocation are so important that they can be used as a relevant competition factor. This depends, in part, on the share of allowance costs in firms' total production costs. For example, CO_2, which is currently (in the absence of affordable „end-of-pipe" technologies) a core „production factor" in all energy intensive activities, and which is currently traded in the EU-ETS at prices that are in the same range as fuel prices, may indeed give rise to significant differences in economic rents between incumbent and new actors. In contrast, pollutants like SO_2 or NO_x usually would represent a lower share of firms' total production costs, but on the other hand market power is likely to be more of an issue that can not be ruled out completely, namely if the allowance markets are narrow (such as the RECLAIM market for SO_x).

Thus, only if at least one of the above-mentioned issues is relevant, then free allocation to new installations/capacity extensions and withdrawal rules are indeed to be recommended from an innovation oriented perspective. Otherwise, it seems more advisable to use a pure "historic" approach without free allocation to new entrants and without shutdown withdrawal rules, in the way implemented in the Acid Rain Program and the RECLAIM programme. Then all of the problems and conflicts of goals mentioned in the course of this paper can be avoided.

If leakage is an issue, but a shutdown rule can not be effectively applied (for instance, due to “cold reserve”/”skeleton plant” strategies, plausible especially in electricity and heat generation), then the leakage prevention achieved with a withdrawal rule may not be worth the associated distortions and conflicts of goals.

If a pure “historic” allocation is applied, then an auction of a share of all allocated allowances, as applied in the Acid Rain Program, can facilitate the market entry for new entrants. Although even on such an auction, „exclusionary“ market power in the sense of Misiolek/Elder 1989 can be exerted, this seems plausible only when a very small portion of the total cap is auctioned. From the auctions under the Acid Rain Program, which comprise 2.8 % of the total cap, no major occurrences or exclusionary market power have been reported.

If free allocation to new installations directly after their start of operation (alternative c) in chapter 3) is chosen, the following aspects should be respected:

Allocation should be according to benchmarks, and not according to the installations’ “needs”. The benchmark can be oriented at the incumbent firms’ average emissions per unit of output, or at BAT standards. In the first case, the incentives for building new installations – and therefore also the innovation effect – is higher, but on the other hand also the implicit „production subsidies” and the firm size distribution and market concentration effects are higher. The two latter effects have ambiguous innovation impacts, and furthermore can be regarded as plausibly leading to static welfare losses. In the view of this author, the choice of benchmark should depend on whether new installations are „converted” to existing installations after some years, and for how many years they will be treated as new entrants. If this period is relatively long, then the author tends to assign a higher importance to the investment incentives, compared to the potential welfare losses from market distortions and increased concentration (although it must be admitted that the latter are also higher when the period of treatment as new entrants is relatively long).

A technology specific benchmark for new installations (e.g., according to fuel types) should in general be avoided. Few exceptions may apply in cases where a portfolio of different technologies shall be promoted – thereby keeping the window of competition between them open. However, uniform benchmarks are normally likely to be the a better choice also for keeping competition open or for helping young, more emission-efficient technologies to overcome barriers from learning effects, infrastructures, or institutions such as beliefs and expectations.

A transfer rule is of high importance for the investment incentives if free allocation to new installations and withdrawal upon closure are applied. This is because a transfer rule can provide at least a part of the incentives for plant replacement that are inherent in pure „historic allocation“ (only a part of these incentives, when the transfer rule is applicable only for some years). Transfer rules also share a part of the leakage problems and the rent distribution problems of historical allocation. In this respect, they must be seen as a „good compromise“, rather than a „best of both worlds“, between pure historical allocation and free allocation to new entrants/shutdown withdrawal. Unfortunately, apparently a „best of both worlds“ does not exist in allowance allocation. At least, transfer rules restrict leakage to those cases where a new plant is replacing the closed plant, which should be regarded as an advantage from an innovation perspective because the new plant is likely to “embody” new technology). Also, if allowance withdrawal can not be enforced legally (e.g., due to „cold reserves“), transfer rules can set incentives to formally close a plant nevertheless, in order to use the allowances for replacing installations.

A transfer rule should be applicable also between legally independent entities. Ideally, in the EU-ETS it would even apply across Member States, so that the nationality of the replacing installation does not become a distorting decision factor, and potential market power of owners of closing plants can not so easily be exerted.

A highly important point is that renewable energy installations should receive free allocation as well, in an amount equal to that for new fossil fuel based installations, in order to avoid preserving the existing energy structure by means of the new entrant rule. If a transfer rule exists, RES must be equally eligible for it. If new renewable energy installations can not receive allowances - for example, due to legal barriers or to political problems[38] – then this would constitute an important argument against any free allocation to new installations at all - or at least for BAT benchmarks rather than average benchmarks, since the latter would even strengthen the discrimination of fossil fuel technologies versus RES. After all, the competition between fossil fuel based installations and RES is regarded by this author as one of the most important components of innovation in energy related environmental policy.

38 For instance, lobbying by nuclear power industry to receive free allowances as well.

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